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Forest Service

**Northeastern
Area**

The Appalachian Integrated Pest Management Gypsy Moth Project

Final Status Report

*Northeastern Area,
State and Private Forestry*

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1994 Status Report

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The Appalachian Integrated Pest Management (AIPM) Gypsy Moth Project

Final Status Report

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The Appalachian Integrated Pest Management (AIPM) Gypsy Moth Demonstration Project

Final Status Report

Introduction

The Problem

The gypsy moth is an insect whose caterpillar stage feeds on the leaves of forest and shade trees (such as oak and maple). During outbreaks, these caterpillars can become so numerous that entire forests are defoliated, often causing loss of tree growth and tree vigor, tree mortality, and disruptions in forest recreation and changes in ecosystem structure and function. The caterpillars often pose a serious nuisance problem in residential areas.

Introduced into North America in 1869, the gypsy moth has steadily expanded its range southward and westward from its introduction point in Massachusetts. In the Northeast, the gypsy moth has developed a pattern of outbreaks mixed with years of low population. During 1981, over 13 million acres were defoliated. Along the so-called *leading edge* or *expanding front* the gypsy moth is in perpetual outbreak. It is in this area that the gypsy moth gets the most attention because neither the forests nor the human population have adapted to it.

Some of the valid reasons for increased concern about the gypsy moth, as it expands its range into the Virginias and beyond into the southern hardwood regions, are:

- ❒ Oak and other susceptible species are more prevalent.
- ❒ Forests are important to the local and regional economy.
- ❒ The climate may be more favorable to the gypsy moth.
- ❒ Following defoliation, a warm, dry climate may cause significant tree mortality.

In response to these increased concerns, Congress provided a supplemental appropriation to the Forest Service in 1987 to initiate the Appalachian Integrated Pest Management (AIPM) Gypsy Moth Demonstration Project. This project was aimed at slowing-the-spread and minimizing the impact of the gypsy moth along the Allegheny Mountains in Virginia and West Virginia. A major focus of the AIPM project was the development of a model Integrated Pest Management Program for use in a large geographic area. A system that uses a variety of methods to manage gypsy moth populations in an environmentally sound manner will prove invaluable as the gypsy moth moves into the southern hardwood region.

The project was designed as a five-year effort and funding for field operations ceased in September, 1992. While some studies begun under AIPM continued through 1993 as part of the National Center of Forest Health Management, 1993 was mainly used to complete data analysis, develop recommendations and document the project. This is the final Status Report for this Project.

The Concept

The AIPM project was based on the concept of Integrated Pest Management (IPM), including:

- ❒ Understanding the biology of the pest and using that knowledge to manage it.
- ❒ Designing and using an extensive monitoring system upon which to base all management decisions.
- ❒ Developing and maintaining a variety of control methods, and matching the best method to each situation.
- ❒ Preventing or reducing damage and losses to levels that were economically, environmentally, and aesthetically acceptable.
- ❒ Maintaining a well-managed forest in order to preserve healthy stands.
- ❒ Education.

The Area

As indicated in Table 1 below, the AIPM project area encompassed over 12.8 million acres.

Table 1. *AIPM Acreage*

	Ownership	Acres (*Thousands*)
State:	Virginia	3,580
	West Virginia	5,140
Federal:	Department of Agriculture	3,870
	Department of Interior	230
Total		**12,820**

Organization

The Northeastern Area, State and Private Forestry, Forest Health Protection office in Radnor, Pennsylvania administered the AIPM project. Overall direction was coordinated through the Project Office located in Morgantown, West Virginia. Field units in Elkins, West Virginia, and Harrisonburg, Virginia were responsible for project implementation.

State and Federal cooperating agencies implemented the project on lands under their jurisdiction. A Program Manager provided oversight for the project from the Morgantown Field Office and a Project Leader directed field operations. A Steering Committee consisting of the line officers of the primary cooperating agencies served as the Project's Board of Directors, making budgetary and management decisions (Appendix I). A Planning Committee of technical experts and field coordinators from all cooperating agencies developed work plans and budgets, and provided technical recommendations to the Steering Committee (Appendix II).

Objectives

The four Project objectives were:

1. Minimize the spread and adverse effects of the gypsy moth within the project area.

2. Develop a prototype integrated pest management structure that can be implemented elsewhere.

3. Evaluate low-level intervention methods for the management of gypsy moth populations.

4. Assess the feasibility of implementing a coordinated county, state, and Federal program over a large area.

The four objectives were successfully completed.

Accomplishments by Objective

Objective 1

Minimize the Spread and Adverse Impacts

Significant advances were made during the life of the project in terms of improving our knowledge of gypsy moth distribution and in minimizing impacts of established populations:

- Over 600,000 acres were treated between 1989 and 1992 to minimize impacts and spread. Impacts were prevented and the treatments successful on 565,000 of these acres.

- The male moth monitoring network gave the first real look at gypsy moth populations and fluctuations over time along the leading edge of the infestation and the rate of spread of the pest was reliably quantified for the first time:

  9.6 km/year (5.7 mi/year) at the 1 moth per trap level

  15.0 km/year (9.0 mi/year) at the 250 moth per trap level

- Methods were developed to locate and successfully reduce building populations in isolated areas beyond the continuously infested area.

Objective 2

Develop Prototype Integrated Pest Management (IPM) Structure

This involves the operational components needed to plan, organize, and implement an integrated pest management approach to gypsy moth management. AIPM has shown that an integrated approach to gypsy moth management must consist of the following components:

- Administrative structure that addresses all cooperators/stakeholders

- Goals and objectives agreed upon by all participants

- Standardized data collection protocols developed and used throughout project area.

- Decisionmaking matrix agreed upon by all participants.

- Standardized evaluation techniques.

- Evaluation criteria and feedback mechanisms.

- Area-wide information and education programs.

Objective 3

Evaluate Methods for Isolated and Low Level Infestations

Elimination of isolated infestations and the maintenance of building gypsy moth populations at a low level are keys to slowing the spread of the pest. Operational methods for dealing with such populations prior to AIPM included the use of chemical insecticides and *Bacillus thuringiensis* (*Bt*). Under AIPM, these methods were improved and major efforts made in regard to:

- Pheromone flakes and beads for mating disruption.
- Evaluations conducted to improve aerial application technology and methods resulted in better accountability of sprayed materials and improved efficiency of applications.
- Conducted evaluations of different dose and application rates of Dimilin®, *Bt*, and Gypchek.
- Evaluated use of Dimilin® against low level populations.
- Non-target impacts of Dimilin®, *Bt* and the gypsy moth itself evaluated.
- Evaluated sterile life stages of gypsy moth for use against low level populations.

Objective 4

Assess the Feasibility of Implementing a Coordinated Integrated Pest Management Program Over A Large Geographic Area

Many diverse state, county, and Federal agencies must work together to achieve the objectives of a large-scale IPM project. Individual agency priorities, objectives, policies and philosophies must be coordinated with broader objectives of the overall project. AIPM has demonstrated that both interagency and intra-agency communications are feasible. To be successful, these programs must:

- Develop an organizational hierarchy
- Establish internal and external communication lines
- Develop and maintain networks
- Stress continuing contacts and coordination

Major Products and Contributions of the Project

In successfully completing the objectives of the project, a number of significant products were developed by the many cooperators in this project. A partial listing of the major contributions of the project includes:

Gypchek ready for operational use.

Pheromone flakes (Disrupt II) available for operational use.

Increased dose and decreased dilutions of *Bt* recommended.

Swath Kit developed and in operational use.

Sequential egg mass sampling method developed.

Geographic Information System (GIS) for data management and decision support placed in operational use.

Prototype GIS developed for local/county level use.

Gypsy Moth in the Classroom, an educational package for kindergarten and fourth grade, developed and placed in over 50 school systems.

Improved National Environmental Policy Act guidelines.

Technology transfer system refined.

Improved aerial application technology.

Improved accountability of aerially applied materials.

New method developed to quantify Dimilin® residues.

Dimilin® impacts quantified on indicator aquatic and terrestrial non-target organisms.

Bt impacts quantified on non-target, canopy-inhabiting arthropods.

Gypsy moth caused defoliation impacts quantified on water quality and native brook trout.

Over 100 brochures, pamphlets, technical reports, refereed journal articles and other publications have resulted thus far from the project (Appendix III).

Additionally, analysis continues on large portions of the data base associated with the project. For example, just two of the interesting preliminary results of these analyses are of potentially great significance to managers in designing intervention programs:

A. Treatments vs Defoliation and Pest Population Reduction

Defoliation

Preliminary results indicate that at low egg mass densities (< 500/acre), the amount of defoliation was similar regardless of whether Dimilin® or *Bt* was used or whether treatment even occurred. These analyses also indicate that treatment with either Dimilin® or *Bt* at higher egg mass densities provided essentially the same degree of protection from defoliation.

Population Reduction

Preliminary analysis of population reduction as measured by change in egg mass density indicates that Dimilin® consistently reduces populations more than *Bt*, with the greatest difference occurring at population densities <2,000/acre. As population densities increase to >4,000/acre, all actions (including no treatment) tend to reduce populations in the following year about the same amount.

These findings are potentially significant to managers as historically, *Bt* has been used against lower population densities and Dimilin® against higher ones. These preliminary results indicate that this approach may not be the best in terms of reducing low level populations. They also indicate that both materials seem to perform equally well in preventing defoliation at all population densities and that both reduce populations to below subsequent treatment thresholds at egg mass densities above about 4,000/acre. Analysis continues to determine if operational changes should be recommended.

B. Relationship of treatment effectiveness vs distance from other defoliating populations

Preliminary analysis tends to confirm what some have felt for some time—that treatments are more effective when areas being treated are not in close proximity to other areas with defoliating populations present.

In addition to the products and other accomplishments outlined above, two other major contributions resulted from AIPM:

The **Slow-The-Spread Pilot Project** being implemented in Michigan, North Carolina, Virginia and West Virginia, is based on the knowledge gained and the improvements in low level treatment tactics developed through the AIPM Project. It builds from the preliminary findings of AIPM that we can, indeed, find and manipulate low level populations and will evaluate our ability to ultimately retard the rate of spread of the pest.

The **National Center of Forest Health Management** was established to capitalize on the jump-start given methods improvement and development by AIPM. The Center is national in scope and will work on technology improvements on major pests and problems affecting forest health. In this, its first year, the Center will finish some of the AIPM-sponsored projects.

Investment

AIPM presented the opportunity to demonstrate the implementation of an integrated pest management process. In addition to evaluating slowing-the-spread and minimizing the impact of the gypsy moth, AIPM provided the opportunity to develop and improve gypsy moth management technology, develop a prototype IPM structure and to determine the feasibility of implementing a coordinated program in a large geographic area including many different cooperators.

The table below provides the annual expenditures by each of the four objectives for the AIPM Program since its establishment in Fiscal Year 1987.

Table 2. *AIPM Expenditures, by Objective.*

Objective	1987/88	1989	1990	1991	1992
			...Dollars in thousands...		
1. Minimize Spread/ Adverse Impacts	00	740	2,282	2,048	2,092
2. Prototype Structure	1,510	2,620	3,431	3,752	4,111
3. New Technology	510	1,080	766	1,753	1,387
4. Coordinated Effort	250	560	464	549	610
Total	**2,270**	**5,000**	**6,943**	**8,102**	**8,200**

Project Recommendations

Define National Gypsy Moth Objectives and Priorities

Currently, the long term Forest Service goals for insect management are defined (Cooperative Forestry Assistance Act of 1978; 1990 Farm Bill; Departmental Gypsy Moth Policy; Gypsy Moth Memorandum of Understanding between the Forest Service and APHIS; 1985 Gypsy Moth Suppression and Eradication Projects Final Environmental Impact Statement as Supplemented and Amended). The AIPM Project represented a microcosm of the Forest Service in that questions regarding annual (short term) allocation of personnel and funds between suppressing potentially damaging population densities and treating to manage or eliminate low level/building populations have to be addressed.

Conflicts also had to be resolved annually regarding funding of treatments in urban/suburban versus forested areas as well as defining realistic measures of treatment success/failure. Some questions were easily resolved, as effective, pest-specific tactics were not operationally available for use against some population densities. As a result of AIPM however, effective tactics do exist for managing all population densities and it may now be appropriate to consider defining Forest Service priorities in these areas in light of agency downsizing, budget reductions, the need to improve service to the public and to emphasize accountability.

Develop and Implement a Coordinated State/Federal Programmatic Approach to Gypsy Moth Management

It was proposed many years ago that a unified, coordinated State/Federal programmatic approach to gypsy moth management be undertaken. This was not done, but one positive outcome of the proposal was the formation of the USDA Gypsy Moth Working Group to address gypsy moth policy issues at the Departmental level. Two reasons the suggestion was not fully implemented were that: (1) effective tactics did not exist for use against all population densities; and (2) the concept itself had not been field tested. As a result of AIPM, effective tactics for use against all population densities are now available, and the project showed that, organizationally and operationally, this approach is feasible. As above, in light of Department and agency downsizing and in the spirit of governmental reinvention and improved service to our publics, we are now in a position to consider developing and implementing a coordinated gypsy moth program with clearly defined, common long-term goals and annual objectives to replace the current department-by-department, agency-by-agency, state-by-state approach.

Reevaluate Cooperative Suppression Cost Share Program

True management of pests is best accomplished against sub-impacting, low population levels. To fully implement the knowledge gained through the AIPM Project, gypsy moth programs stressing

monitoring and low level population intervention must be included in the overall suppression/eradication/prevention approach to gypsy moth management. This would mean a fundamental shift in the gypsy moth management paradigm, requiring that States be encouraged to request funds for work against low level gypsy moth populations. While Federal suppression funds are theoretically available for this purpose, for many reasons they historically have been requested only for use against high and potentially damaging populations. AIPM was successful in working against low-level populations only because it provided 100% of the funds necessary to do those jobs with no cost share required from the Cooperators. As the Forest Service moves toward implementation of the concept of ecosystem management, consideration should be given to reevaluating the current Cooperative Suppression Cost Share Program to take full advantage of all available gypsy moth management knowledge and to ensure that management of this past will be part of the management of the ecosystems involved.

Develop a National Gypsy Moth Information Program

No pest management program can be successful without the support of the public. This support can only be gained through extensive and coordinated information development, dissemination and outreach efforts. Each department, agency and state currently develops its own information programs and approaches. This results in significant duplication and inefficiencies (e.g. unit-by-unit preparation and publication of pamphlets, brochures, video materials, etc.). It also results in confusion on the part of the public and numerous missed opportunities. A national gypsy moth information program, building on the organizational and multiagency coordination knowledge and experience gained through the AIPM Project, would solve these problems. The program could be conducted in partnership with other Federal and State agencies, and would provide single-point focus of informational document development and dissemination. Costs could be shared and products developed that would allow each partner to personalize each product with their own logo. This concept could be expanded to cover other pests over time.

Glossary

Bacillus thuringiensis *(Bt)*
A bacterium used widely in insecticides against the gypsy moth. Effective against moderate or heavy populations, *Bt* prevents defoliation but sometimes fails to reduce populations to acceptable levels. It affects some caterpillars other than the gypsy moth.

BIU
Billion International Units = international units of potency per mg. A standardized measure of biological potency.

Dimilin® (Diflubenzuron)
A synthetic insect growth regulator that is effective in protecting foliage and reducing gypsy moth populations. Dimilin® is potentially detrimental to other insects and organisms.

Disrupt II
Plastic flakes that are impregnated with artificial gypsy moth pheromone and dispensed aerially to disrupt mating in low-level gypsy moth populations (see "Pheromone Confusants").

GIS
Geographic Information System - a computerized system where basic data is stored for number crunching and map displays.

Gypchek
A formulation of a naturally-occurring virus that affects only gypsy moths. It is effective in protecting foliage and in reducing gypsy moth populations.

Low-Level Intervention
Methods used against low-level gypsy moth populations. These methods require intensive monitoring of the gypsy moth population, and are expensive and sometimes labor-intensive. Although considered operational, all require technical improvement to make them more reliable and economical.

Mass Trapping
A method in which pheromone-baited traps containing an insecticide strip are placed throughout an area. Male moths are attracted to these traps and are killed before mating with females in the area.

NEPA
National Environmental Policy Act - Establishes a national policy to encourage productive and enjoyable harmony between man and the environment, to promote efforts that will prevent or eliminate damage to the environment and stimulate the health and welfare of man, to enrich the understanding of the ecological systems and natural resources important to the Nation, and to establish a Council on Environmental Quality.

NEPA process

All measures necessary for compliance with the requirements of Section 2 and Title 1 of NEPA.

Pheromone Confusants

Flooding an area with an artificial version of the gypsy moth sex pheromone. Confused by this, the males are unable to locate females (see "Disrupt II").

Sterile Life Stages

Gypsy moth eggs or male pupae are sterilized and introduced into an area. After developing, the adult males mate with native females resulting in sterile offspring.

Swath Kit

A portable system developed to assist in the calibration and characterization of aircraft prior to the initiation of operational spraying.

Appendix I - *Steering committee*

R-8 Forest Pest Management (Co-chair)

Northeastern Area Forest Health Protection (Co-chair)

Northeastern Forest Experiment Station

Virginia Department of Agriculture and Consumer Services

West Virginia Department of Agriculture

Shenandoah National Park

Blue Ridge Parkway

George Washington National Forest

Jefferson National Forest

Monongahela National Forest

Appendix II - *Planning Committee*

Federal

NA Forest Health Protection
R-8 Forest Pest Management
George Washington NF
Jefferson NF
Monongahela NF
Blue Ridge Parkway
Shenandoah NP
New River Gorge
NE Forest Experiment Station
USDA APHIS
USDA ARS
US EPA

State/Other

VA Department of Agriculture and Consumer Services
VA Department of Forestry
WV Department of Agriculture
WV Division of Forestry
WV University
Virginia Polytechnic Institute and State University
Environmental Action
Private Industry (WESTVACO)

Appendix III - *List of Major AIPM-Sponsored Publications*

AIPM Brochure: *Why Should I Be Concerned About the Gypsy Moth*

AIPM Booklet: *Managing Gypsy Moths in the Appalachians*

AIPM Appalachian Gypsy Moth Integrated Pest Management DemonstrationProject; one page leaflet; Yellow for WV; Green for VA

USDA Forest Service, Management Bulletin R8-MB 33; *AIPM Final Environmental Impact Statement*; February 1989

AIPM Leaflet, *AIPM Intervention Tactics*

AIPM Contact List, *AIPM County Extension Agents in West Virginia*

AIPM Contact List, *AIPM County Gypsy Moth Coordinators and Extension Agents in Virginia*

The Gypsy Moth in the Classroom, Looseleaf curriculum package for elementary schools plus a video describing classroom activities.

AIPM Field Exercises

Trapping

Gypsy Moth Egg Mass Hunt

Burlap Banding for Gypsy Moth Caterpillars

Tree Identification

NA Technical Publications

Aerial Application Handbook

Aerial Application of Racemic Disparlure to Manage Low-level Populations of Gypsy Moth, 1989

The Gypsy Moth Nuecleopolyhedrosis Virus Product

Swath Kit, A New Aircraft Characterization Tool

Characterization of Lateral Spray Deposit Using Two Aerially Applied Formulations of Bacillus thuringiensis

Sequential Sampling Plans for Estimating Gypsy Moth Egg Mass Density

Appendix III - List of Major AIPM Sponsored Publications

AIPM Brochure: Why Should I Be Concerned About My Gypsy Moth

AIPM Booklet: Managing Gypsy Moth in the Appalachians

AIPM Appalachian Gypsy Moth Interpretive Exhibit (two panels)
Demonstration Video (one page leaflet), Yellow Ice Water Cream for VA

USDA Forest Service - Virginia Version Bulletin: FS MB 39: AIPM Final Environmental Impact Statement - Gypsy Moth

AIPM Leaflet: Gypsy Moth Quarantine

AIPM Control Act, AIPM Laws by Section - Gypsy Moth Regulations

AIPM Quarter Line, AIPM Quarterly Newsletter, Vital Connections and Information Applicable to Virginia

The Gypsy Moth in the Classroom, Gypsy Moth Education Program for elementary schools (1 to 6 grades) - Gypsy Moth Classroom Activities

AIPM Mold Exercises

Trapping

Gypsy Moth Life Stage Flyer

Hunting Banding for Gypsy Moth Caterpillar

Tree Identification

NIA Technical Publications

Aerial Application Handbook

Aerial Application of Insecticide Formulations to Attract Large Numbers of Gypsy Moth, 1980

The Gypsy Moth Nucleopolyhedrosis Virus Product

Stock A.I. A New Virus Characterization Tool

Characterization of Larval Gypsy Dispersal Using Two Aerially Applied Formulations of Bacillus thuringiensis

Sequential Sampling Plans for Estimating Gypsy Moth Egg Mass Density

Coopers Rock Demonstration Project: A Decision Support System for Gypsy Moth Managers

Development and Status of the Sterile Insect Technique for Managing Gypsy Moth

Development of Geographic Information System Technology for Gypsy Moth Management within a County: an Overview

Evaluation of Three Application Rates of Bacillus thuringiensis: Efficacy and Deposit Analysis

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